Small Business Innovation Research/Small Business Tech Transfer

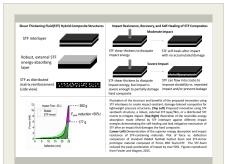
# Impact-Resistant, Damage-Tolerant Composites with STF Energy Absorbing Layers, Phase I



Completed Technology Project (2017 - 2017)

#### **Project Introduction**

We propose an innovative hybrid composite that combines the smart energyabsorbing shear thickening fluids (STF) with validated hard upper torso composite materials to create new STF composite structures with superior impact and damage resistance and self-healing functionality. The proposed innovation directly addresses the subtopic H04.01 need for thin, lightweight composite materials that can be fabricated in complex geometries. STFs are currently being developed by NASA and STF Technologies LLC for use in enhanced puncture and MMOD protective softgoods to improve astronaut survivability. Here, we propose to exploit the unique energy-absorbing properties of shear thickening fluids and prior work by the team, which developed advanced energy absorbing STF materials for sports and military applications, to meet the challenge metrics of a pressure structure composite capable of withstanding 300J of energy in low velocity impact with a structural density of 1.7 g/cm3 or less and thickness of 0.125" or less. The proposed work will combine experiments and modeling to determine the optimal integration of STF with the current best composite materials in the Z-2 suit prototype. The project will leverage the Z-2 suit specific expertise of our partners at UD's Center for Composite Materials (UD-CCM) to develop and test concepts and advance the TRL of new lightweight, damage-tolerant and potentially self-healing hybrid composites. The conformable nature of the STF is amenable to fabrication of complex curved geometries, while the flowable STF within the hybrid laminate can offer healing and leak mitigation after damage. Rapid prototyping, downselection, and validation will be performed in collaboration with UD-CCM, commercialization partners, and NASA scientists and engineers through a combined computational/experimental program with feedback refinement that exploits the unique expertise of all teams.



Impact-Resistant, Damage-Tolerant Composites with STF Energy Absorbing Layers, Phase I Briefing Chart Image

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#### **Primary U.S. Work Locations and Key Partners**



Organizations Performing Work	Role	Туре	Location
STF Technologies, LLC	Lead Organization	Industry	Newark, Delaware
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Delaware	Texas

# Organizational Responsibility

# Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

#### **Lead Organization:**

STF Technologies, LLC

#### **Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

### **Project Management**

#### **Program Director:**

Jason L Kessler

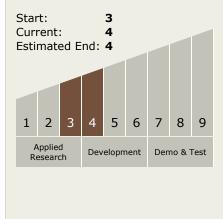
#### **Program Manager:**

Carlos Torrez

#### **Principal Investigator:**

Richard Dombrowski

# Technology Maturity (TRL)





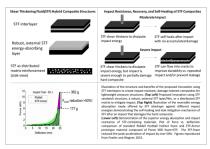
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#### **Images**



#### **Briefing Chart Image**

Impact-Resistant, Damage-Tolerant Composites with STF Energy Absorbing Layers, Phase I Briefing Chart Image (https://techport.nasa.gov/imag e/129499)

## **Technology Areas**

#### **Primary:**

- TX06 Human Health, Life Support, and Habitation Systems
  - └─ TX06.2 Extravehicular
    Activity Systems
    └─ TX06.2.1 Pressure
    - ☐ TX06.2.1 Pressure Garment

## **Target Destinations**

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System

